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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/766,739	01/29/2004	Kazuhide Abe	OKI.612	2843

20987 7590 01/15/2009

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EXAMINER	
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ART UNIT	PAPER NUMBER
2814	

MAIL DATE	DELIVERY MODE
01/15/2009	PAPER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KAZUHIDE ABE

Appeal 2008-4986
Application 10/766,739
Technology Center 2800

Decided: January 15, 2009

Before TERRY J. OWENS, PETER F. KRATZ, and
ROMULO H. DELMENDO, *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

The Appellant appeals under 35 U.S.C. § 134(a) from the Examiner's rejection of claims 12-16 and 28-34, which are all of the pending claims. We have jurisdiction under 35 U.S.C. § 6(b).

The Invention

The Appellant claims a wiring structure of a semiconductor device. Claims 12 and 28 are illustrative:

12. A wiring structure of a semiconductor device, comprising:

a first insulating film having plural grooves formed therein, which has an interface in a horizontal direction between adjoining grooves;

plural wiring films formed in the grooves of the first insulating film to protrude above the interface;

plural barrier films formed on bottoms of the wiring films, and formed on side faces of the wiring films to a height exceeding the interface; and

plural cap films formed at least on upper faces of the wiring films, and which are each separated by the grooves,

wherein the first insulating film has plural protrusions protruding from the interface, and the grooves are formed in the protrusions,

wherein the upper faces of the wiring films and the barrier films are substantially coincident with upper ends of the grooves, and

wherein the protrusions are formed through etching the first insulating film, using the cap films as a mask, and the cap films have substantially the same shape as uppermost faces of the protrusions.

28. A wiring structure of a semiconductor device, comprising:

a first insulating film having plural protrusions in which grooves are formed, and which has an interface in a horizontal direction between adjoining protrusions;

plural wiring films embedded in the grooves on barrier films;

plural first cap films formed on upper faces of the protrusions; and

second cap films formed on the first cap films and the first insulating film,

wherein the protrusions are formed through etching the first insulating film, using the first cap films as a mask, and the cap films have substantially the same shape as uppermost faces of the protrusions.

The References

Higashi	6,342,444 B1	Jan. 29, 2002
Lim	6,380,084 B1	Apr. 30, 2002
Yu	6,958,291 B2	Oct. 25, 2005 (filed Sep. 4, 2003)

The Rejections

The claims stand rejected under 35 U.S.C. § 103 as follows: claims 12-15 and 33 over Lim in view of Higashi, and claims 16, 28-32, and 34 over Lim in view of Higashi and Yu.

OPINION

We affirm the Examiner's rejections.

Rejection under 35 U.S.C. § 103 of claims 12-15 and 33 over Lim in view of Higashi

The Appellant argues claims 12-15 and 33 as a group (App. Br. 5-10; Reply Br. 2). We therefore limit our discussion to one claim in that group, i.e., claim 12. *See* 37 C.F.R. § 41.37(c)(1)(vii) (2007).

Issue

Has the Appellant shown reversible error in the Examiner's determination that the applied references, collectively, disclose each element of claim 12?

Findings of Fact

Lim discloses "the formation of dual damascene copper interconnects in the manufacture of integrated circuit devices" (col. 1, ll. 10-12). The Examiner relies upon Lim's second dielectric layer 72 (Fig. 14) as corresponding to the Appellant's first insulating film having plural grooves (one of which is shown in a hillock in Lim's Fig. 11) and, between adjoining grooves, an interface in a horizontal direction (horizontal surface of second

dielectric layer 72 on each side of the hillock) (col. 6, ll. 50-60) (Ans. 3). The Examiner relies upon Lim's second copper layers 84 (one of which is shown in Fig. 14) as corresponding to the Appellant's plural wiring films formed in the grooves of the first insulating film to protrude above the interface (col. 7, l. 56 – col. 8, l. 19) (Ans. 3). The Examiner relies upon Lim's shielding layer 56 and third barrier layer 80 as corresponding to the Appellant's plural barrier films formed on bottoms of the wiring films, and formed on side faces of the wiring films to a height exceeding the interface (Fig. 14) (col. 5, ll. 13-27; col. 7, ll. 28-39) (Ans. 3). The upper faces of Lim's wiring films and barrier films are flat and are substantially coincident with upper ends of the grooves, which are stripe-shaped (Fig. 14). The Examiner relies upon Lim's hillocks (one of which is shown in Fig. 14) as corresponding to the Appellant's plural protrusions protruding from the first insulating film's interface and having the grooves therein (Ans. 3).

Higashi discloses a semiconductor device comprising an insulating film (1) having a groove therein (Fig. 1G), a TiN barrier layer (5) on the bottom and sides of the groove and protruding above the insulating film surface, a copper layer (6) that fills the space within the barrier layer and has an upper surface coincident with that of the barrier layer (Fig. 1G), and a self-aligned TiN barrier layer (9) on the upper surfaces of the copper layer and the barrier layer (col. 4, ll. 20-24, 43-45, 57-58). Higashi teaches that the semiconductor device has "reduced wiring capacitance and wiring resistance, and the [sic] good barrier and uniformity properties" (col. 2, ll. 13-15).

Yu discloses a semiconductor device comprising a dielectric layer (120) having therein a groove containing a barrier layer (140) and,

filling the space within the barrier layer, a conductor (160), wherein the barrier layer and the conductor protrude above the upper surface of the dielectric layer and have coincident upper faces (col. 5, ll. 23-29; Fig. 7). In one Yu embodiment a passivation layer (170) overlies the conductor and the dielectric layer (col. 5, ll. 25-27). In another Yu embodiment "a conductive passivation layer (not shown) can be formed only overlying the second conductor as a capping layer" (col. 5, ll. 33-35). Yu's conductive passivation layer (not shown) preferably is self aligned (col. 5, ll. 35-36).

Analysis

The Appellant argues that Higashi's cap film (TiN layer 9) is formed only on copper layer 6, whereas the Appellant's cap films are formed at least on the upper faces of the wiring films, not only on the wiring films (App. Br. 8).

The Appellant's claim limitation "formed at least on upper faces of the wiring films" encompasses formation only on the upper faces of the wiring films. Moreover, Higashi's TiN layer 9 actually is formed not only on copper layer 6, but also on the upper surface of TiN layer 5 (Fig. 1G).

The Appellant argues that Higashi's TiN layer 9 would not extend onto the hillock of Lim's second dielectric layer 72 immediately surrounding second copper layer 84/third barrier layer 80 (App. Br. 8).

The Appellant's claim 12 requires that the cap films are formed at least on upper faces of the wiring films. The claim does not require that the cap films extend onto the insulating film surface.

The Appellant argues that Higashi's TiN layer 9 could not possibly have substantially the same shape as uppermost faces of the hillock and, if

anything, would have substantially the same shape as the uppermost face of the wiring (App. Br. 8-9; Reply Br. 2).

The Appellant's claim 12 requires that the cap films have substantially the same shape as uppermost faces of the protrusions, not the insulating film. Higashi's TiN layer 9 would have substantially the same shape as the uppermost faces of the protrusions formed by Lim's hillock, third barrier layer 80 and second copper layer 84, i.e., flat and stripe shaped (Lim, Fig. 14).

Conclusion of Law

The Appellant has not shown reversible error in the Examiner's determination that the applied references, collectively, disclose each element of claim 12.

Rejection under 35 U.S.C. § 103 of claims 16, 28-32, and 34 over Lim in view of Higashi and Yu

The Appellants argue claims 16, 28-32, and 34 as a group (App. Br. 10-14; Reply Br. 3-5). We therefore limit our discussion to one claim in that group, i.e., claim 28. *See* 37 C.F.R. § 41.37(c)(1)(vii) (2007).

Issue

Has the Appellant shown reversible error in the Examiner's determination that the applied references would have rendered the invention claimed in the Appellant's claim 28 prima facie obvious to one of ordinary skill in the art?

Analysis

The Appellant relies upon the above-discussed arguments set forth with respect to claim 12 (App. Br. 10-13; Reply Br. 3-4).

For the reasons given above regarding claim 12, we are not persuaded by those arguments.

The Appellant argues that Yu's conductive passivation layer (not shown) appears to be similar to Higashi's TiN layer 9, and is formed only on the wiring, not on the wiring and the insulating film (App. Br. 13-14; Reply Br. 4-5).

The Appellant's claim 28 requires "plural first cap films formed on upper faces of the protrusions". That claim limitation is met by Higashi's TiN layer 9 (col. 4, ll. 44-46, 57-58) or Yu's self-aligned conductive passivation layer (not shown) (col. 5, ll. 33-35).

The Appellant's claim 28 also requires second cap films formed on the first cap films and the first insulating film. Yu's passivation layer 170 is formed on both conductor 160 and dielectric layer 120 (col. 5, ll. 23-29; Fig. 7). Yu would have led one of ordinary skill in the art, through no more than ordinary creativity, to apply Yu's passivation layer over Yu's self-aligned conductive passivation layer or Higashi's self-aligned TiN barrier layer 9 and the insulating layer surrounding them to provide passivation of those layers. *See KSR Int'l. Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007) (In making an obviousness determination one "can take account of the inferences and creative steps that a person of ordinary skill in the art would employ"). *See also KSR*, 127 S. Ct. at 1740 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill").

Conclusion of Law

The Appellant has not shown reversible error in the Examiner's determination that the applied references would have rendered the invention claimed in the Appellant's claim 28 prima facie obvious to one of ordinary skill in the art.

DECISION/ORDER

The rejections under 35 U.S.C. § 103 of claims 12-15 and 33 over Lim in view of Higashi, and claims 16, 28-32, and 34 over Lim in view of Higashi and Yu are affirmed.

It is ordered that the Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

PL Initial:
sld

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